

EE-352 Final Examination/ Fall2011-2012

Answer all questions

Time 120 min.

1- اكتب رقم تسلسل اسمك بقائمة الأسماء الصادرة عن المنضومة وكذلك رقم المجموعة (درجتان)

2- A 100 KVA, 11000/2200 V, 60 Hz single phase transformer gave the following test results:

a- Open circuit test: 2200 V, 1.59 A, 980 W.

b- Short circuit test: 580 V, 9.1 A, 1100 W.

Find:

1- Equivalent circuit referred to 11000 V side.

2- Maximum efficiency of transformer at unity power factor.

3- Voltage regulation at 75 % load, 0.8 Lagging power factor. [10]

3- Three single-phase 100 KVA, 11000/ 2200 V transformers are connected to form three phase Δ/λ bank. Each transformer has $12 + j 60 \Omega$ equivalent impedance referred to its high voltage side. If the bank is connected to 12000 volts [line to line], while it delivers its rated current at 0.8 lagging power factor, find:

a- Line to line load voltage.

b- Percentage voltage regulation.

c- Bank efficiency.

4- For the uniform air-gap machine shown in fig-1, If coil inductances are $L_{af} = M \cos \theta_0$, $L_{bf} = M \sin \theta_0$, $L_{aa} = L_{bb} = A$, $L_{ff} = B$, $L_{ab} = 0$, while coil resistances are neglected. Coil currents are $i_a = i_{\max} \cos(628t)$ A, $i_b = i_{\max} \sin(628t)$ A, $I_f = I$ A. The rotor is rotated at ω_r rad/sec, such that rotor position at any time is given by $\theta_0 = \omega_r t - \delta$.

find:

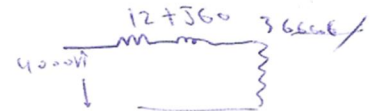
a- Instantaneous torque.

b- Rotor speed at which average torque is obtained.

c- Average torque.

d- Maximum average torque, and at what angle it occurs. [10]

$$\frac{1}{2} (3 \cdot i_{\max} \sin(628t) (-M \sin \theta_0))$$

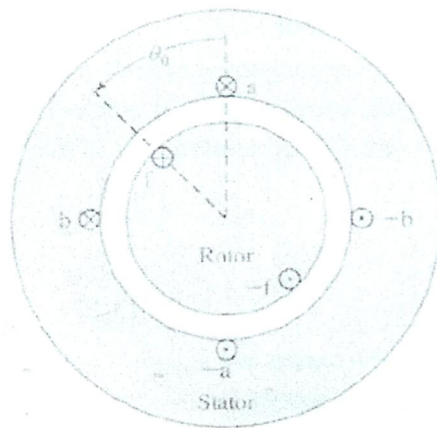


5- The non-uniform air-gap machine shown in fig-2 below has winding inductances as:

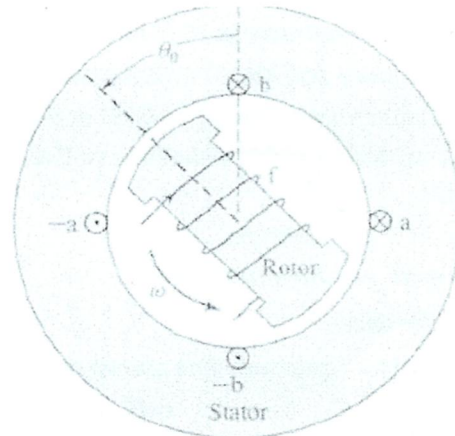
$$\begin{aligned}
 L_{aa}^{ss} &= L_0 + L_2 \cos 2\theta, & L_{bb}^{ss} &= L_0 - L_2 \cos 2\theta \quad H \\
 L_{af}^{sv} &= M \cos \theta, & L_{bf}^{sv} &= M \sin \theta, & L_{ff}^{rr} &= A \quad H, & L_{ab}^{ss} &= L_2 \sin 2\theta \\
 \theta &= \omega t + \delta, & i_a &= \sqrt{2} I \cos(\omega t + \delta) \quad A
 \end{aligned}$$

If the field winding on the rotor is supplied by dc current I_f while no current flows in winding b, find:

- Developed torque.
- Average torque, and show its components.
- Maximum average torque of each component, and when it occurs [16]
- Draw approximate graphs of average torque..



Fig(1)



Fig(2)

(26)

BMW

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Answer all questions

90
time {120 min}

Q1: Choose the correct answer only:

[20, 12]

✓ 1- Transformers are used to:

- a- Change the voltage and b
b- Change the current
c- both a

✓ 2- In transformers, leakage flux is reduced by:

- a- Separating the transformer's windings
b- Placing the transformer's windings closer together
c- Using iron cores
d- Both b and c.

✓ 3- Transformers have maximum efficiency when operating at:

- a- Full load unity power factor
b- winding copper losses equal to iron core losses
c- both a and b.

✓ 4- Magnetic fields compared to electric fields:

- a- Have higher energy density
b- Have lower energy density
c- Have equal energy density.

✓ 5- Developed electro-magnetic force always acts in a direction:

- a- To decrease the total inductance
b- To increase the total inductance
c- To increase the total reluctance.
d- to decrease the stored field energy

6- Synchronous speed is dependent on:

- a- The supply frequency
b- the number of poles
c- both a, and b
d- none of a, and b.

7- In a p -pole machine, mechanical degrees are:

- a- $(p/2)$ of the electrical degrees
b- (p) of the electrical degrees
c- $(2/p)$ of the electrical degrees
d- none of a, b, or c.

8- Rotating magnetic fields, rotate in the direction:

of phase sequence

~~Hysteresis & flux density~~

11

(27)

phase sequence

- a- Of phase sequence independent of phase sequence b- opposite to ~~phase sequence~~ c-

✓ Q2: A 240 KVA, 2400/240 V, transformer has the equivalent circuit shown in fig 2, is used to supply a load whose impedance is $\{(1.843 + j13.8) \times 10^{-2} \Omega\}$. Find:

[40, 13]

- 1- The current I_1 , transformer copper losses, core losses.
- 2- Output power, input power, and overall power factor.

✓ Q3: For the singly excited system shown in fig 1, the fixed and moving members, are made of magnetic material of infinite permeability, find:

[40, 13]

- a- The total reluctance as function of position y .
- b- The total inductance of the circuit $L(y)$.
- c- The maximum inductance of the circuit.
- d- The stored field energy $W_f(\lambda, y)$.

✓ Q4: A rotating machine has a coil inductance $L(\theta) = 0.06 + 0.03 \cos. 4\theta$ H

- a- What are the maximum and minimum values of inductance, and at what angles they occur?
- b- If a current of $[i = \sqrt{2} * 10 \sin(314t) \text{ A}]$ flows through the coil, find:

[40, 12]

- 1- Instantaneous developed torque as function of θ .
- 2- ~~average~~ maximum torque as function of θ .

and at what angle θ it occurs.

[2]